UNCLASSIFIED

AD NUMBER
ADB036730
LIMITATION CHANGES
TO: **Approved for public release; distribution is unlimited. Document partially illegible.**
FROM: **Distribution authorized to U.S. Gov't. agencies only; Test and Evaluation; 01 MAY 1979. Other requests shall be referred to Air Force Logistics Command, AFLC/LOTP, Wright-Patterson AFB, OH 45433.**
AUTHORITY
usaflcom ltr, 8 dec 1983

THIS PAGE IS UNCLASSIFIED

AD B036730

AUTHORITY: USAFLCom

1tr 8 Dec 83

(15 January 1979)
DISTRIBUTION LIMITED to U. S.
Government agencies only; ~~report~~ T&E
~~involves evaluation of commercial products~~.
Other requests for this document must be
referred to AFLC/LOTP, Wright-Patterson
AFB OH 45433.

1 MAY 1979

PTPT REPORT NO. 79-1
AFPEA PROJECT NO. 77-P7-43

FRANK C. JARVIS

Mechanical Engineering Technician

Autovon 787-4519

Commercial (513)257-4519

See back page for 1473

EVALUATION OF AN "ISOPOD" REUSABLE SHIPPING CONTAINER FOR THE F-16 FIRE CONTROL RADAR SYSTEM COMPONENTS

HQ AFALD/PTP
AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433

January 1979

NOTICE

ABSTRACT

The evaluation of the Hughes Standard "Isopod" reusable container revealed that this container will adequately protect the F-16 Fire Control Radar System during rough handling situations encountered in shipment. The maximum shock level recorded during the evaluation was 12 Gs. Field test data of a shipment of the actual radar system components are included in this report.

This Agency obtained 18 surplus "Isopod" containers and incorporated the necessary restraining brackets and hardware to reduce the damage potential to the radar components during the loading and unloading sequence. These containers will be available, as government furnished equipment, to the manufacturer of the radar system for shipment of production installs.

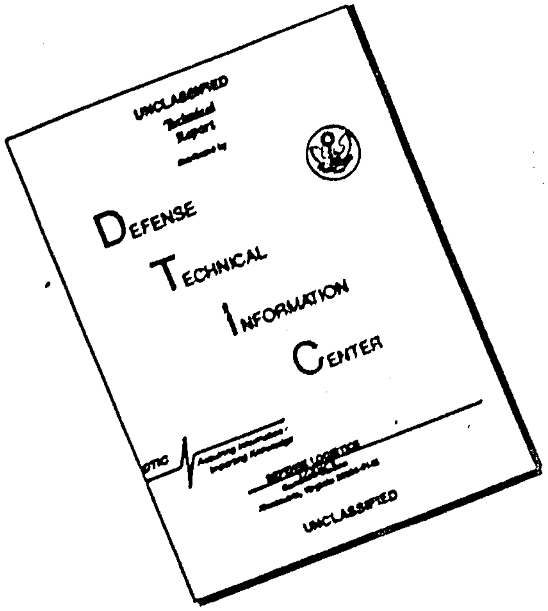
PREPARED BY: Frank C. Jarvis
FRANK C. JARVIS, Mechanical Engineering Technician, Materials Engineering Div. AF Packaging Evaluation Agency

PUBLICATION DATE:
6 FEB 1979

REVIEWED BY: Matthew A. Venetos
MATTHEW A. VENETOS

APPROVED BY: Jack E. Thompson
JACK E. THOMPSON

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

Acknowledgements

The following AFPEA personnel are acknowledged for their contribution toward the success of this project:

Capt Joseph J. Beradino

James D. Heck

Ronald Vantu

Ernest Vanzant

Robert Rosenkranz

TABLE OF CONTENTS

FIGURES

TABLES

INTRODUCTION

Beginning in 1976, the Air Force Contract Management Division (AFCMD/PDT) and the Air Force Packaging Evaluation Agency (AFPEA) cooperated in a program to investigate the use of reusable containers for shipping the F-16 Fire Control Radar System components. The use of this container versus the existing wooden crates could result in an estimated cost savings of approximately $600,000.

This Agency obtained 18 surplus Hughes Standard "Isopod" containers and initated a test program to evaluate this container. Early in the test program it was recognized that a damage potential existed for the radar antenna during the loading and unloading phase. This problem was eliminated by installing a slide/guide mechanism on the bottom shelf of the "Isopod".

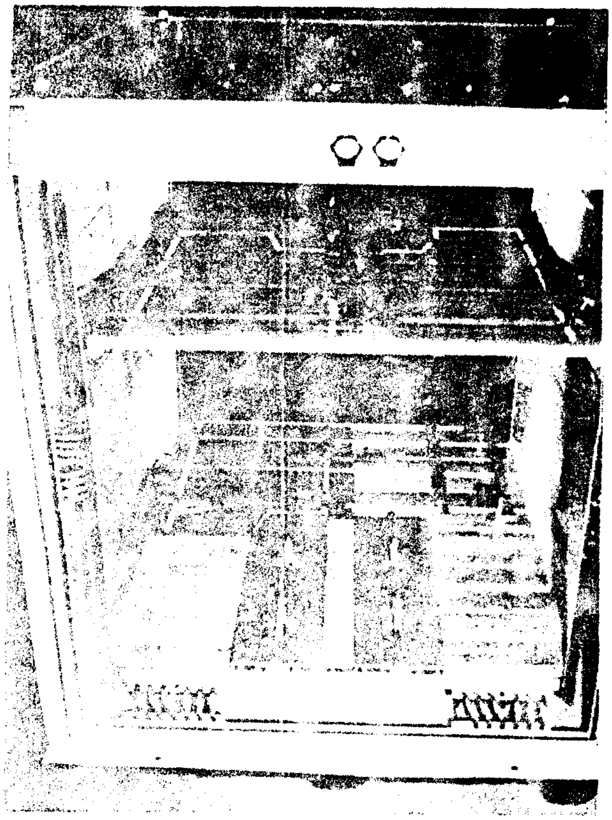
DESCRIPTION OF TEST PACK

The Hughes Standard "Isopod" aluminum container (P/N K1012750, NSN 8145 00 180 5802) includes a molded plastic pallet which is bolted to the container base and an extruded aluminum shelf assembly which is isolated from the container shell with 8 "Aeroflex" helical shock mounts. Soft vinyl-rubber pads are bonded to the shelf surface and will compress when an item is strapped in place. A desiccant compartment and humidity indicators, with controlled breathing valves, are included with the Standard "Isopod". The two weather sealed access doors are secured with 6 latching devices per door. The container was designed for a load range of 100 to 350 pounds and a shock protection level of 20 Gs. Two models were tested and each was identical in construction except for the height, weight and capacity. The majority of the tests were conducted with the 48 inch high container. A comparison of the two models is shown in Table I.

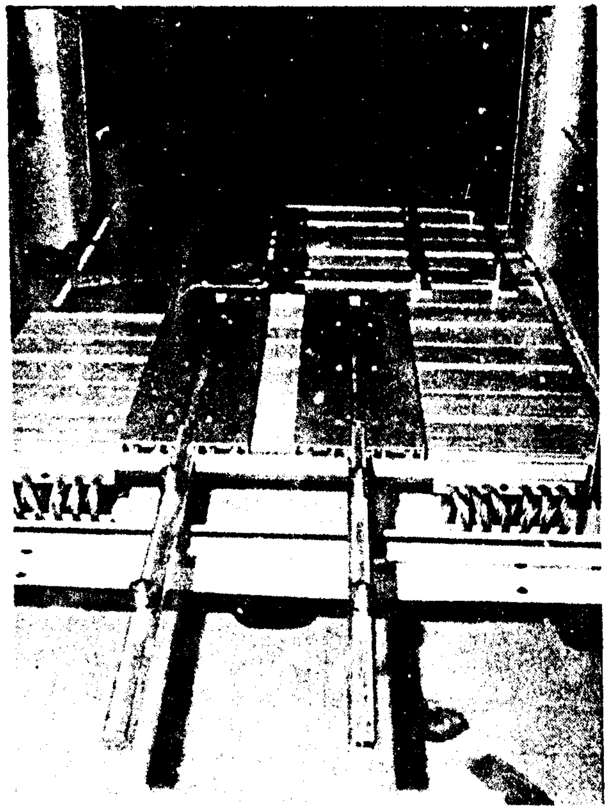
Model Number	Dimensions (Inches)	Tare Weight (Lbs)	Cargo Capacity (Ft.^{3})
K1012750	48 X 40 X 48	210	26.5
K1102234	48 X 40 X 60	263	35.5

Table I. Model Comparison Information

A modified container is shown in figure 1. The slide rail guide assembly is required to prevent damage to the delicate antenna surface when the antenna is placed on the container shelf. A special bracket assembly (right rear), for the transmitter, was used in place of the strap assemblies to secure the item to the lower shelf. The tension on the strap could damage the thin dust cover on the top front surface of the transmitter.



(a) Modified Shelf Assembly



(b) Antenna Rails Extended

Figure 1. Modified Standard Isopod

TEST INSTRUMENTATION AND EQUIPMENT

The following instrumentation and equipment were employed during this evaluation:

Instrumentation:

1. Oscilloscope, 4 channel storage, Tektronix Model 564-B

2. Accelerometer, tri-axial, Endevco Model 2233E

3. Amplifier (3 ea.), Endevco Model 2614C

4. Power Supply, Endevco Model 2622C

5. Transportation Environment Recorder, Bolt-Beranek and Newman, Models 711 and 714

Equipment:

1. Vibration Test Machine, (mechanical) L.A.B. Corp., Type 5000-96B

2. Vibration Test Machine, (mechanical) L.A.B. Corp., Model 41012

3. Low-Temperature Test Chamber, Tenny Engineering, Inc.

4. Environmental Rain Chamber, Harshaw Chemical Company

5. Chain Hoist, electrical

TEST PROCEDURES AND RESULTS

All of the tests, except as noted, were conducted in accordance with Federal Test Method Standard 101B. Tri-axial and single accelerometers were secured to the simulated models of the radar components and to the shelf sections of the isolation system. One phase of the testing included the installation of a tri-axial accelerometer at the center of gravity of the simulated computer component. Figure 2 shows the locations of the simulated components.

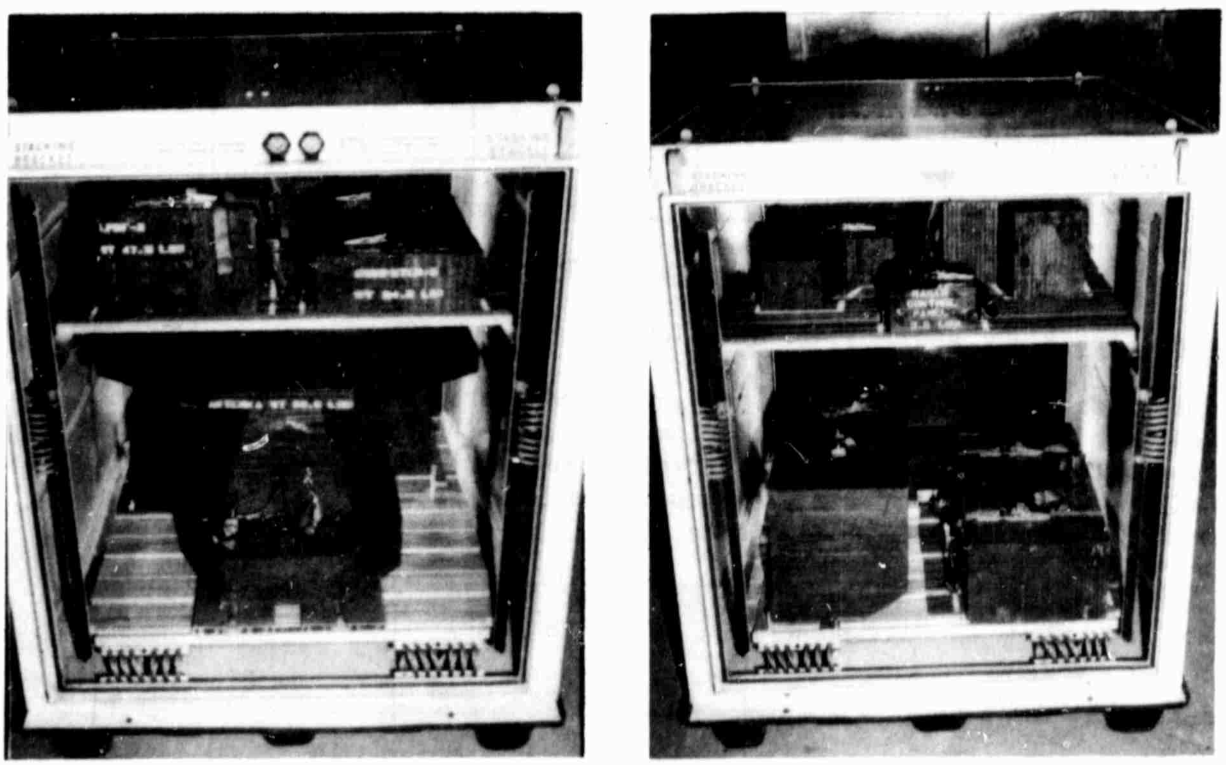


Figure 2. Simulated Models of the Radar Components

The location of each item was carefully selected to provide the proper center of balance for the test pack.

Repetitive Vibration Test - Method 5019

During the initial vibration test the lower angle brackets, which support the lower shelf assembly, fractured and prevented the completion of the tests. The Hughes Company was contacted and informed of this failure. They were aware of the problem and informed this Agency that the later models of the Standard "Isopod" included the redesigned shelf angle brackets which were later supplied to this agency for the replacement of the defective brackets. The 18 surplus "Isopods" were inspected and the lower shelf angle brackets were replaced as required.

To insure that the redesigned bracket would support the test load, a 4 hour repetitive vibration test was substituted for the standard 2 hour test.

After the antenna and transmitter restraining devices were installed an additional 2 hour vibration test was performed to determine if the mounting integrity could be maintained. The vibration data for each of the two test models are presented in Table II.

Test Pack Model Number	Antenna & Transmitter Mounts		Frequency	Response Acceleration (Peak to Peak)
	with	without	HZ	G
K1012750	X	-	4.8	5.0
K112234	-	X	4.2	4.2

Table II. Repetitive Vibration Test Data

Resonant Frequency and Transmissibility

To insure that the Aeroflex helical shock isolators would not weaken or become distorted, a one hour vibration test was substituted for the normal 15 minute test. The test pack was rigidly secured to the vibration table and vibrated at the resonant frequency of the test pack. Both light and heavy load data is included in Table III.

Model Number	Test Load Weight (Lbs)	Resonant Frequency HZ	Acceleration - G (Peak to Peak)		Transmissibility Factor
			Table	Test Load	
K1012750	107	14	2	9.5	4.75
	263	7.5	2	5.0	2.50

Table III. Resonant Frequency & Transmissibility Data

Pendulum Impact Test - Method 5012

The maximum peak acceleration recorded on the four impacted surfaces of each test pack was 10.2 Gs.

Edgewise Rotational Drop Test - Method 5008

Each test pack was subjected to method 5008 tests with the exception of paragraph 6.1. The greatest attainable height was substituted for the recommended 36 inch height. An unstable condition existed above the heights listed in Table IV.

Model	Drop Height (In)	Impact Edge	Peak Acceleration - G	
			Ambient	-40°F
K1012750	30	2-3	11.0	12.2
	30	4-3	12.0	10.6
	24	5-3	9.0	9.2
	24	6-3	10.0	8.0
K1102234	20	2-3	9.7	-
	20	4-3	8.4	-
	20	5-3	9.4	-
	20	6-3	10.0	-

Table IV. Drop Test Data

Additional edgewise drop test data was obtained for the light (107 lbs.) load. This data is shown in Table V.

Model No.	Drop Height (In)	Impact Edge	Acceleration - G				Duration
			X	Y	Z	R	msec
K1012750	30	2-3	17	4	10	20.1	35
	30	4-3	4	4	18	18.9	50
	24	5-3	12	8	20	24.7	40
	24	6-3	10	10	15	20.6	50

Table V. Additional Drop Test Data (107 lb load)

Wind Driven Rain Test, MIL-STD-810C, Method 506.1

The 48 inch high test pack was exposed to a two hour, 40 MPH, wind driven rain test. The inspection revealed that no water or condensation was present inside the container.

Field Tests

Two separate field tests were conducted with the Standard "Isopod". The first shipment was made September 1977 with the simulated models of the radar components and the second shipment of the actual radar components occurred in September 1978.

Shipment 1: Truck transportation was used for this shipment from Baltimore, Maryland to Fort Worth, Texas. A Transportation Environment Recorder (TER) was used to monitor the test load environment. The non-resultant TER will only record the individual shock inputs from three mutually perpendicular accelerometers and; therefore, the unknown resultant value will be slightly higher. This data is presented in Table VI.

Shock Level Range (Gs)	Number of Shocks Recorded			Elapsed Time (Days)
	X	Y	Z	
2.5 - 5.0	18	7	*	7.2

* Accelerometer inoperative
Temperature range: 50 - 100°F (80 - 90° for 2.2 days)
Humidity range: 30-60% (50-60% for 2.4 days)

Table VI. Field Test Data, Shipment 1

Shipment 2: Field test number 2 consisted of two containers with the actual radar components as shown in figure 3. For security reasons the Low Power RF component is not shown. The Transportation Environment Recorder is shown on the right side of the antenna. The radar systems were shipped from Baltimore MD via commercial air, to Fort Worth TX. The two "Isopods" were later transferred to a military aircraft

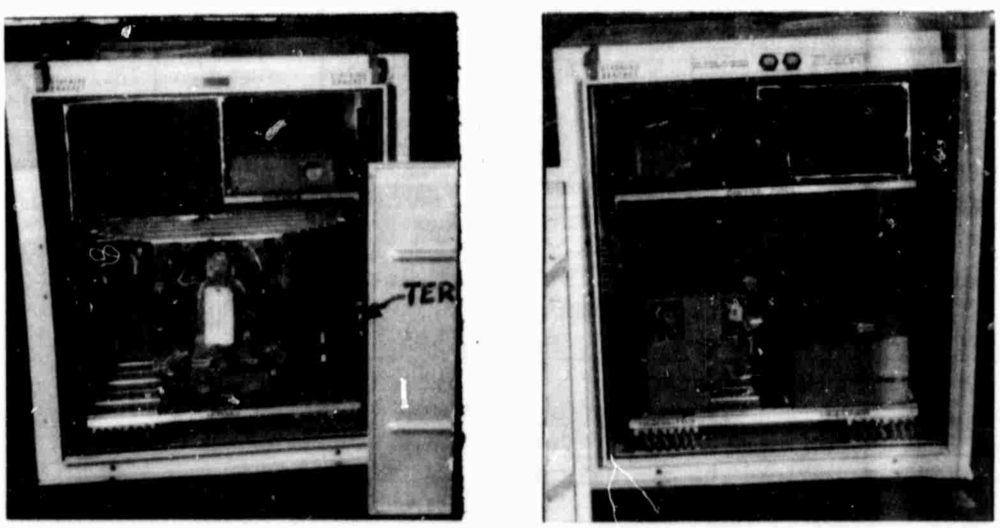


Figure 3. F-16 Radar Components

for the final flight to Europe. One system, instrumented with the TER, was delivered to Belgium and the second system, instrumented with "Impact-O-Graph" indicaters was delivered to the Netherlands. The TER data is listed in Table VII. The resultant type TER records individual shock inputs in three mutually perpendicular axes (X, Y, Z) and immediately computes and records the resultant value of the X, Y and Z components.

Shock Level Range (Gs)	Number of Shocks Recorded X Sides	Y Front-Back	Z Top-Bot.	Resultant	Elapsed Time (Days)
2.5 - 5.0	1	0	7	33	23

Table VII. Field Test Data, Shipment 2

The larger number of shocks recorded as resultants are due to shock and vibration inputs whose individual X, Y & Z components are below the recorders "threshold" setting of 2.5 G and, therefore, not recorded in the X, Y & Z channels. However, when these low level components are combined, the resultant value is above the 2.5 G "threshold" and, therefore, is recorded.

The two "Impact-O-Graph" shock indicators used in monitoring the shipment to the Netherlands were not activated which indicated that the "Isopod" isolation system did not receive a shock input above 15 Gs. The two indicators (15 & 25 G) were calibrated in the laboratory prior to installation in the "Isopod".

The low shock level values experienced during these tests were expected since the rough handling tests produced a maximum of 12 Gs.

DISCUSSION

The test load positions and the condition of the Aeroflex shock isolators were monitored during all phases of the rough handling tests. No damage occurred to either the test load, the container or the shock mounts. Some separation (1/16 to 1/8 inch) occurred between the strands of cable which formed the helical coils of the lower shock mounts. This separation appeared to be a normal characteristic of the coil and did not affect the performance of the isolation system.

The inspection of the surplus containers which were not tested revealed that the welded joint, which frames the access door openings, had small cracks on some of the corners. Since this type of fracture did not occur on any of the test models it is suspected that they were caused by improper latching of the door locking mechanism. If the door is not properly inserted into the framed opening and the locking mechanism strikes the outer edge, the forces generated by the lever arm could shear the pin on the lock or force the frame to separate if continued abuse occurred. This crack would not be serious unless it propagated beyond the door seal. If so, water could enter the container. Rewelding was required to correct this problem which existed on only one of the 18 "Isopods".

The inspection also revealed that one of the containers was punctured with a fork lift truck. This hole was repaired by welding.

Additional details of the rough handling tests are provided in AFPEA Interim Reports no. T-77-34 and 78-8.

CONCLUSIONS

1. The Standard "Isopod" will provide adequate protection for the F-16 Fire Control Radar System which has a fragility rating of 25 Gs.

2. The Aeroflex helical shock mounts are not effected by rough handling tests including drop tests at -40°F.

3. The antenna rail/guide assembly and the transmitter attachment bracket assembly is adequate for securing these items to the "Isopod" shelf assembly.

RECOMMENDATIONS

1. The contractor responsible for the packaging of the F-16 Fire Control Radar System should be required to use the modified surplus "Isopods" for the production installs. Three of the 18 "Isopods" are in the possession of the Air Force Plant Representative Office (AFPRO) at the packaging site and the remaining 15 containers are available immediately upon request. The estimated value of these modified GFE containers is approximately $50,000. The use of these reusable containers in place of the wooden crates now used by the contractor would result in estimated cost savings of $600,000 for the factory install shipping program.

2. The four corners of each access door frame should be reinforced on all future models of this container to prevent cracks in the weld of the corner joint.

DISTRIBUTION LIST

HQ USAF/LETN Wash DC 20330	1
AGMC/DMTP Newark AFS OH 43055	2
Aviation Supply Office ATTN: TEP-A Philadelphia PA 19111	1
Commander US Army Natick R&D Ctr/DRXNM/EPS Natick MA 01760	1
NWC-Earle Colts Neck NJ 07722	1
DESC/LQP 1507 Wilmington Pike Dayton OH 45444	1
JMPTC Aberdeen Proving Ground MD 21005	2
ADTC/SD3E Eglin AFB FL 32542	1
ADTC/SDMT Eglin AFB FL 32542	1
OO-ALC/DSTC Hill AFB UT 84406	1
OC-ALC/DSPA Tinker AFB OK 73145	1
SA-ALC/DSP Kelly AFB TX 78241	1
SM-ALC/DSP McClellan AFB CA 95652	1
WR-ALC/DSP Robins AFB GA 31098	1
Tobyhanna Army Depot/DRXTO-TP-S Tobyhanna PA 18466	1
HQ AFSC/LGT Andrews AFB DC	1
AFALD/PT	1

DISTRIBUTION LIST (cont'd)

AFLC/LOT	1
AFALD/PTP Library	20
ASD/AWL	1
AFALD/PTPP	1
DDC-TC (Accessions Division) Alexandria VA 22314	12
DLSIE/DRXMC-D US Army Logistics Management ATTN: Mr. Malcolm Alley Fort Lee VA 23801	2
AFPRO/IR Westinghouse Defense & Electronic System Ctr. P.O. Box 1693 Baltimore MD 21203	1
AFPRO/PD, P.O. Box 371 General Dynamics ATTN: Rick Stenzil Ft. Worth Division Ft. Worth TX 76101	1
AFPRO/PD (J. Maloney) Westinghouse Defense & Electronic System Ctr. P.O. Box1693 Baltimore MD 21203	1
AFPRO/PD ATTN: Rick Gibbons Pratt & Whitney Aircraft West Palm Beach FL 33402	1
AFCMD/PDT ATTN: Jim Rorie Kirtland AFB NM 87115	1
ASD/YPM (Mrd. Medeiras) WPAFB OH 45433	2
AFALD/SDM (Ron K denruth) WPAFB OH 45433	1
AFCMD/CASEUR, DET 3 ATTN: Don Abbott APO NY 09667	1
ASD/RAOF PRAM ATTN: Joe White WPAFB OH 45433	1

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
14 PTPT [redacted]o.-79-1

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
6 EVALUATION OF AN "ISOPOD" REUSABLE SHIPPING CONTAINER FOR THE F-16 FIRE CONTROL RADAR SYSTEM COMPONENTS

5. TYPE OF REPORT & PERIOD COVERED

6. PERFORMING ORG. REPORT NUMBER
AFPEA Project No. 77-P7-43

7. AUTHOR(s)
10 Frank C. Jarvis

8. CONTRACT OR GRANT NUMBER(s)
12 16p.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
AFALD/PTPT
Wright-Patterson AFB OH 45433

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
AFALD/PTP
Wright-Patterson AFB OH 45433

12. REPORT DATE
11 15 Jan[redacted]79

13. NUMBER OF PAGES
14

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)
Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

F-16 radar, Isopod, reusable container, Aeroflex isolators, shock test, field tests

403 519 Jru

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The evaluation of the Hughes Standard "Isopod" reusable container revealed that this container will adequately protect the F-16 Fire Control Radar System during rough handling situations encountered in shipment. The maximum shock level recorded during the evaluation was 12 Gs. Field test data of a shipment of the actual radar system components are included in this report.

This Agency obtained 18 surplus "Isopod" containers and incorporated the necessary restraining brackets and hardware to reduce the damage potential to the radar components during the loading and unloading sequence. These containers

Cont'

CONT

20. will be available, as government furnished equipment, to the manufacturer of the radar system for shipment of production installs.

THIS REPORT HAS BEEN DELIMITED
AND CLEARED FOR PUBLIC RELEASE
UNDER DOD DIRECTIVE 5200.20 AND
NO RESTRICTIONS ARE IMPOSED UPON
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.